



Test Technology Division  
West Desert Test Center,



U.S. Army Dugway Proving Ground

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### **A New M&S Tool to Supplant Decontamination Testing: The Decontamination Efficacy Prediction Model (DEPM)**

December 13<sup>th</sup>, 2006

12th Annual ITEA Modeling and Simulation Conference  
*Las Cruces, New Mexico*

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# Briefing Outline

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- History/Background
- Model Structure
  - Key Object Classes
  - Key Objects
- Agent Flow Diagrams
  - Contamination & Aging Phase
  - Decon Phase
  - Residual Hazard Phase
- Questions?



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# History/Background

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# Historical Background

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- First envisioned as a way to model the survivability of contaminated equipment to enhance and support decon testing
- Effort initiated in 2003 by the Chemical Test Division of DPG as the Equipment Contamination Survivability Tool (ECS), funded by the Virtual Proving Ground Program of the Army's Developmental Test Command at APG
- Initial phase of effort was the completion of a document search of existing models and databases throughout DoD (2003-2004)



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# Historical Background (cont'd)

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- In 2005 the Dayton OH branch of Anteon Corp. was selected to begin initial design of the ECS Model architecture
- First demonstration of a proof-of-principle prototype made in September 2005 at DPG. Model development continued through 2006 with VPG funding.
- With termination of the VPG Program in FY2006, the project transitioned to a combined test/model program funded by DTRA/JSTO and led by the Decon Sciences Group at ECBC, with the modeling phase managed by DPG.



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# Historical Background (cont'd)

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- The ECBC program, known as the CREATIVE project, redirected the modeling effort to simulation of contamination/aging/decontamination of test coupons of various materials in a chamber environment
- Concurrent with the redirection the new model was renamed the Decontamination Efficacy Prediction Model. A second recent change was the purchase of Anteon Corp. by General Dynamics to be part of its new GDIT Division
- Near term effort is directed at reaching a prototype capability for modeling coupon contamination and decontamination (by end of CY06)



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# What is the Decontamination Efficacy Prediction Model (DEPM)?

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- The DEPM is a software tool designed to simulate the decontamination of material items
- Provides a “Virtual Chamber” to subject simulated items to the four key phases:
  - Contamination
  - Aging
  - Decontamination
  - Residual Hazard



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# Potential Benefits of the DEPM

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- Not meant to replace all laboratory tests – will complement
- Allows paring down of live testing case matrices
- Allows a wider spectrum of contamination and environmental conditions to be explored
- Provides a platform to test complex items or collections of items – testing not generally possible in chambers with live agent



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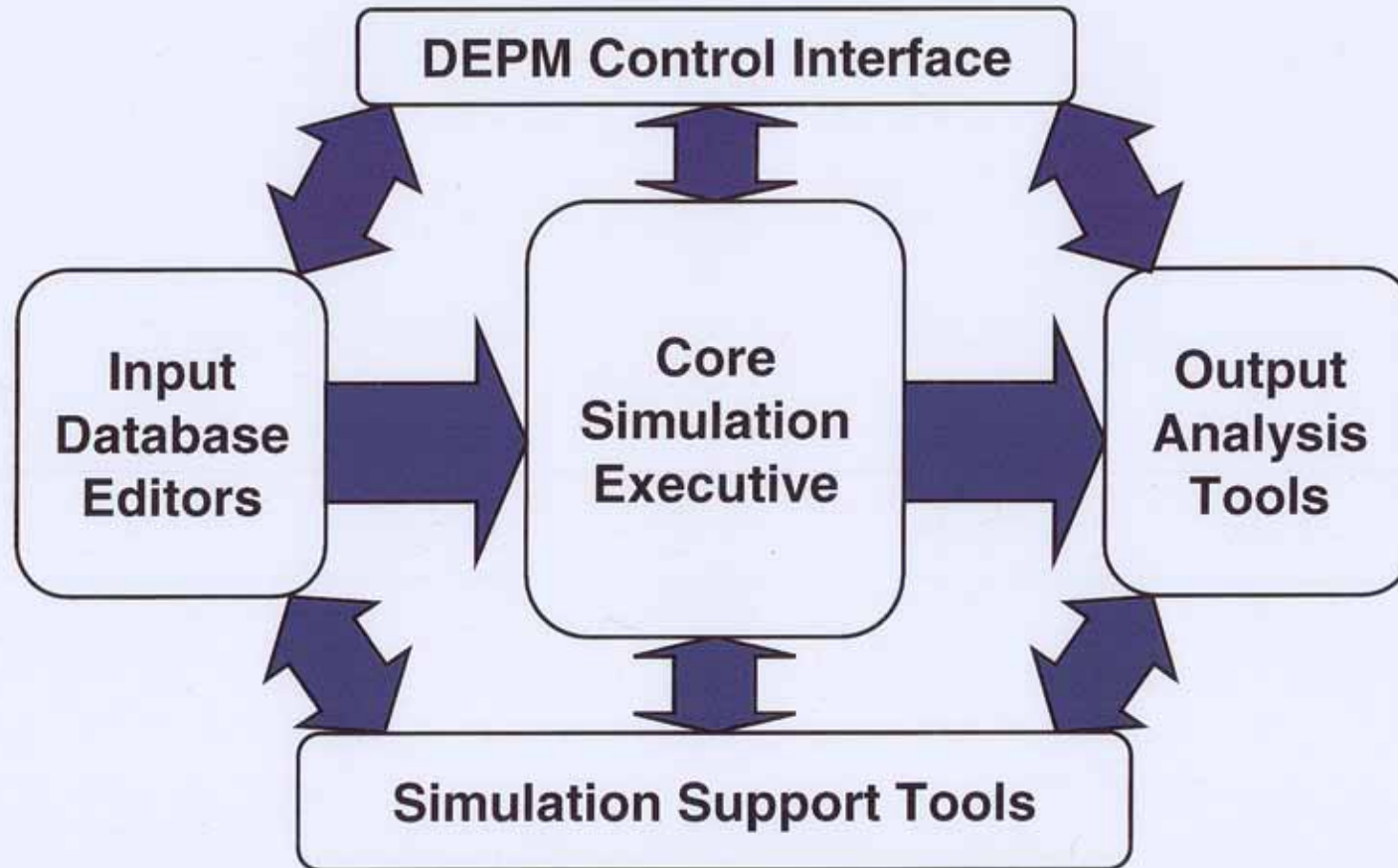
# Model Structure

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# DEPM Model Structure

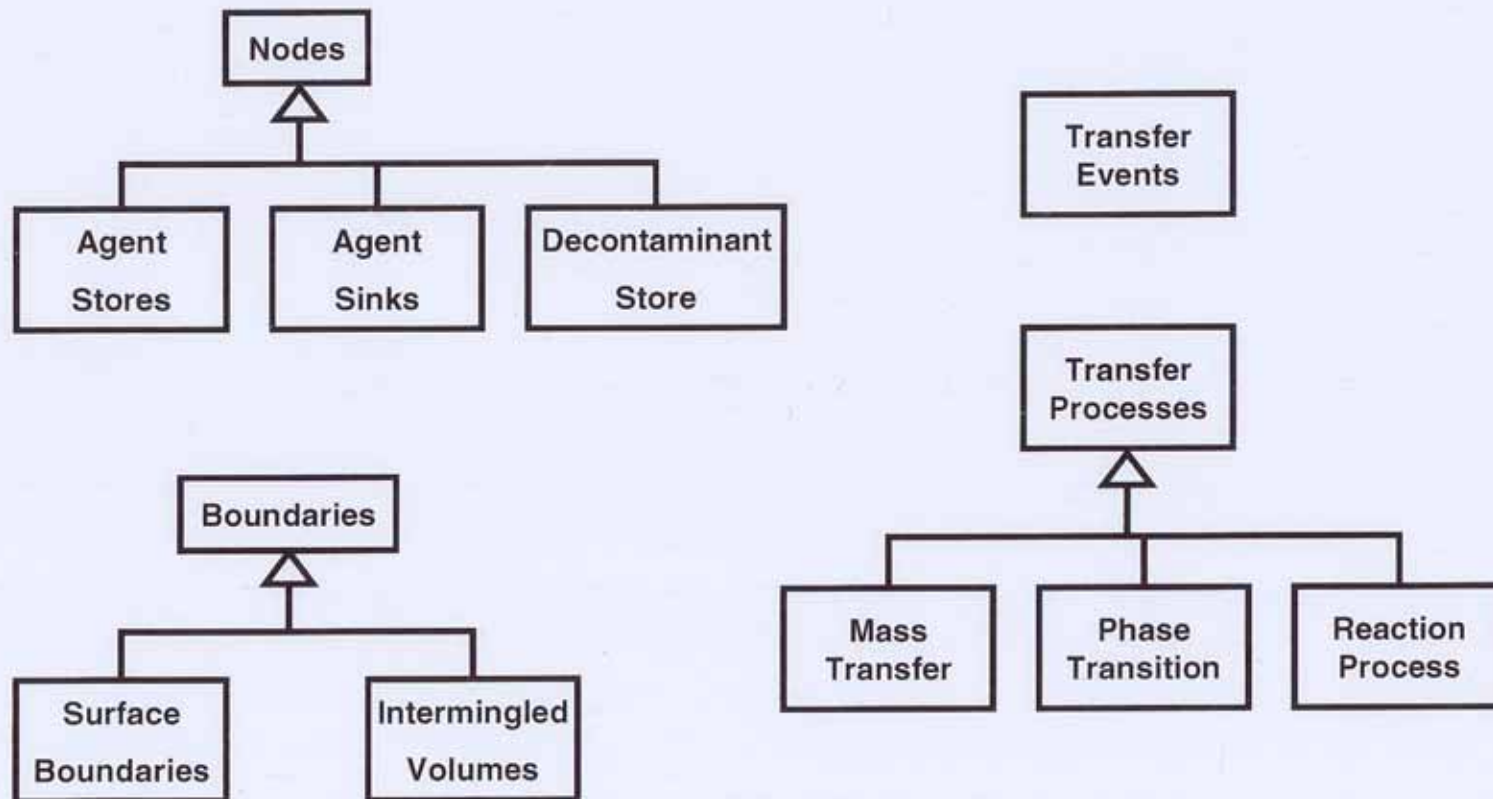


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# Key Object Classes (Generalized)



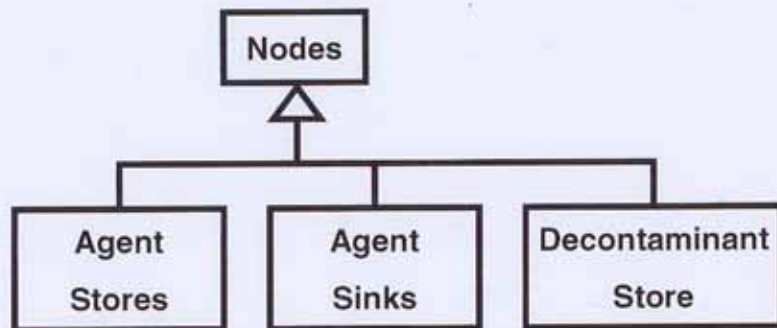
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# Stores and Sinks Object Classes

- Objects of these classes “contain” quantity of agent or decontaminant
- Mass can transfer into or out of Stores
- Mass can only transfer into Sinks
- A store is assumed to be of homogenous material



- Key Object Attributes:
  - Current Mass (units: *mass*)
  - Rate of Change (units: *mass/unit time*)





# Transfer Event Object Classes

- **Transfer Events**  
Objects are used to represent the transfer of agent mass into or out of a store/sink that is assumed to occur at a discrete point in time (rather than over a period of time)

Transfer  
Events

- **Key Object Attributes:**
  - **Varies by Specific Object**
  - **Typically: mass, percent/fraction transferred, etc.**



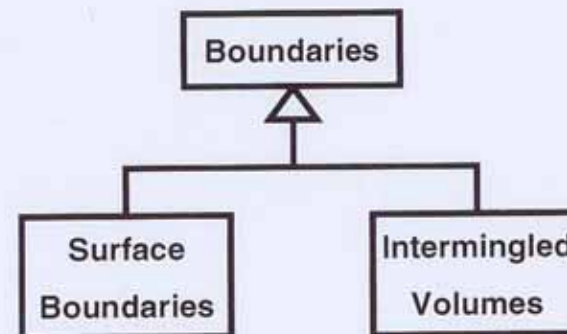
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# Boundary Object Classes

- **Boundary Objects** represent the “boundary” between agent stores/sinks
- These objects work with **Transfer Process Objects** to represent the flow of agent from store to store/sink
- “**Intermingled Volumes**” are used to represent the boundary between agent/decontaminant stores that occupy the same “space” – typically used with reaction processes

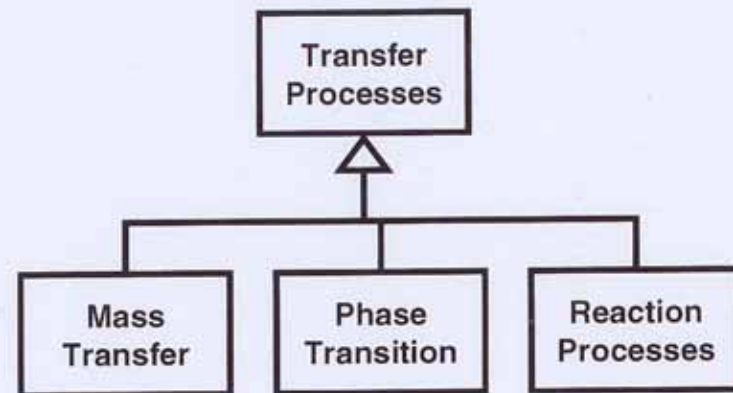


- **Key Surface Object Attributes:**
  - **Surface Area** (units: *area*)
- **Key Volume Object Attributes:**
  - **Volume** (units: *volume*)



# Transfer Object Classes

- **Transfer Objects work with Boundary Objects to represent the transfer/ transformation of agent mass between stores and sinks**





# Agent Flow Diagrams

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# Agent Flow Diagrams

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- The following slides show the general flow of agent mass from store to store/sink via boundaries using various transfer processes



***Agent***



***Decontaminant***



***Reaction Product***



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# Phases Represented in Simulation

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- Contamination & Aging
- Decontamination
  - Physical Removal
  - Vapor – Vapor Decon
  - Surface Decon
  - Substrate Penetration Decon
- Residual Hazard
  - Residual Evaporation
  - Contact Hazard



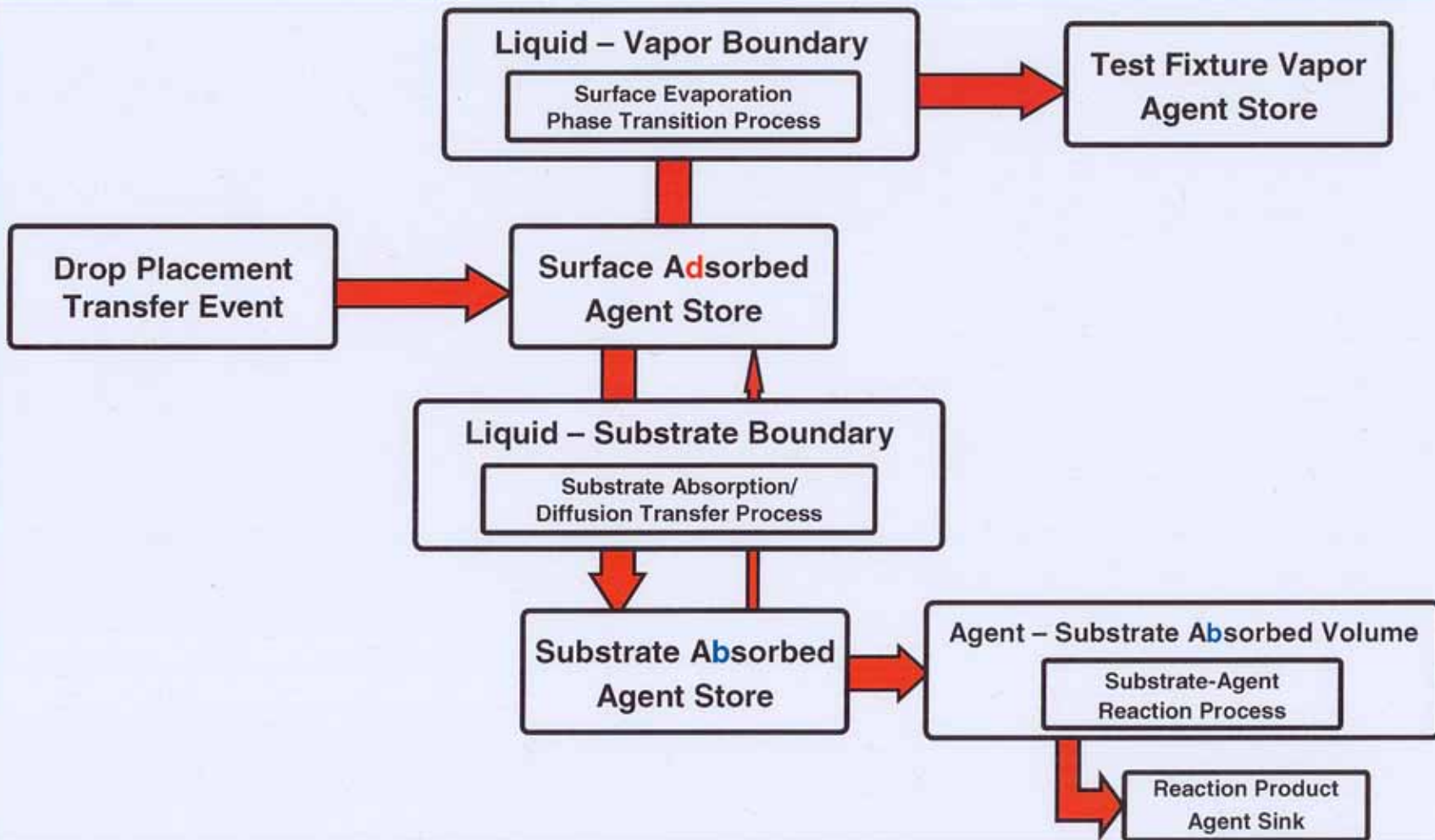
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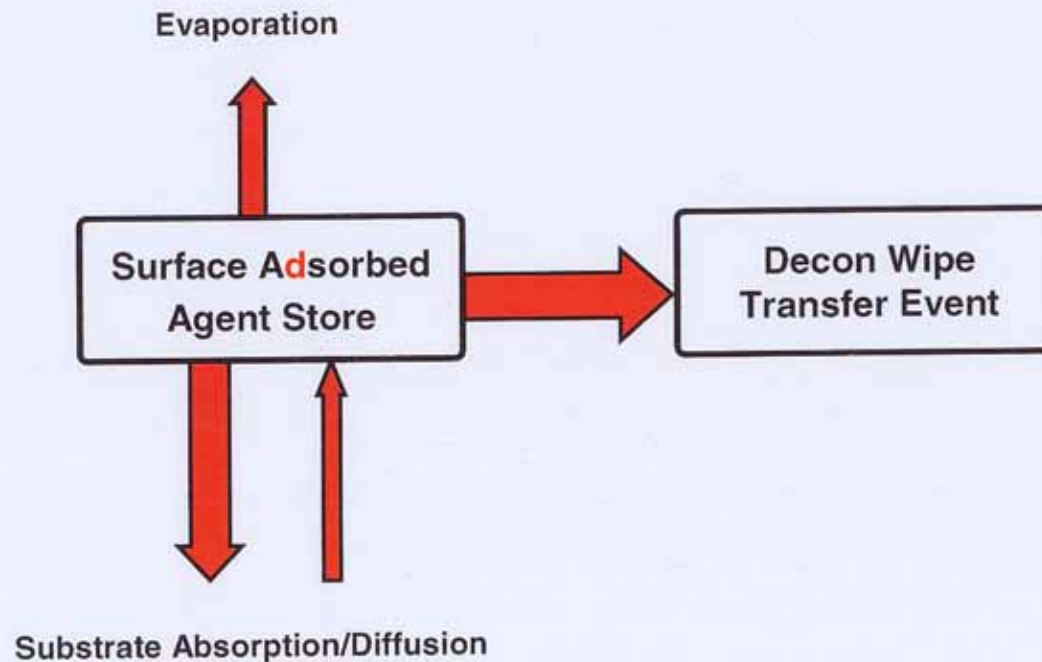
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# Agent Flow: Contamination & Aging Phase



# Agent Flow: Decontamination Phase (Physical Removal)

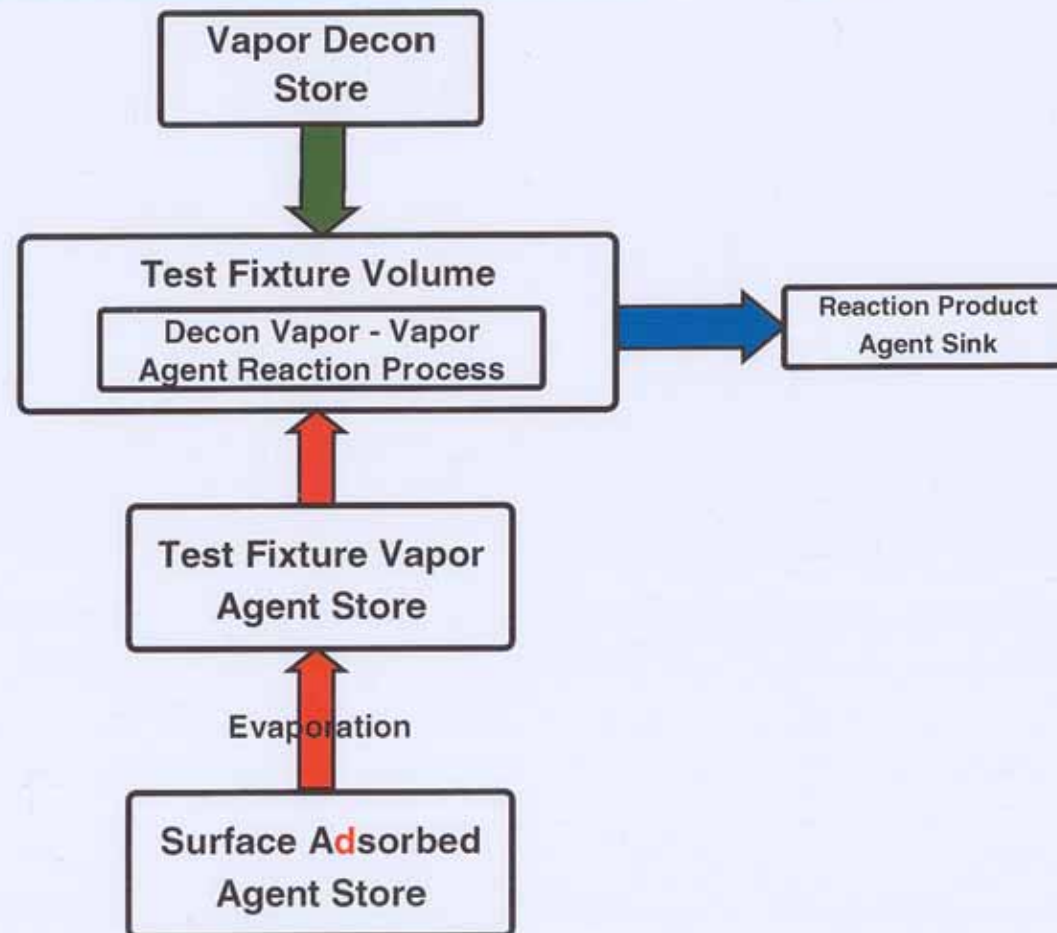


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# Agent Flow: Decontamination Phase (Vapor - Vapor Decon)



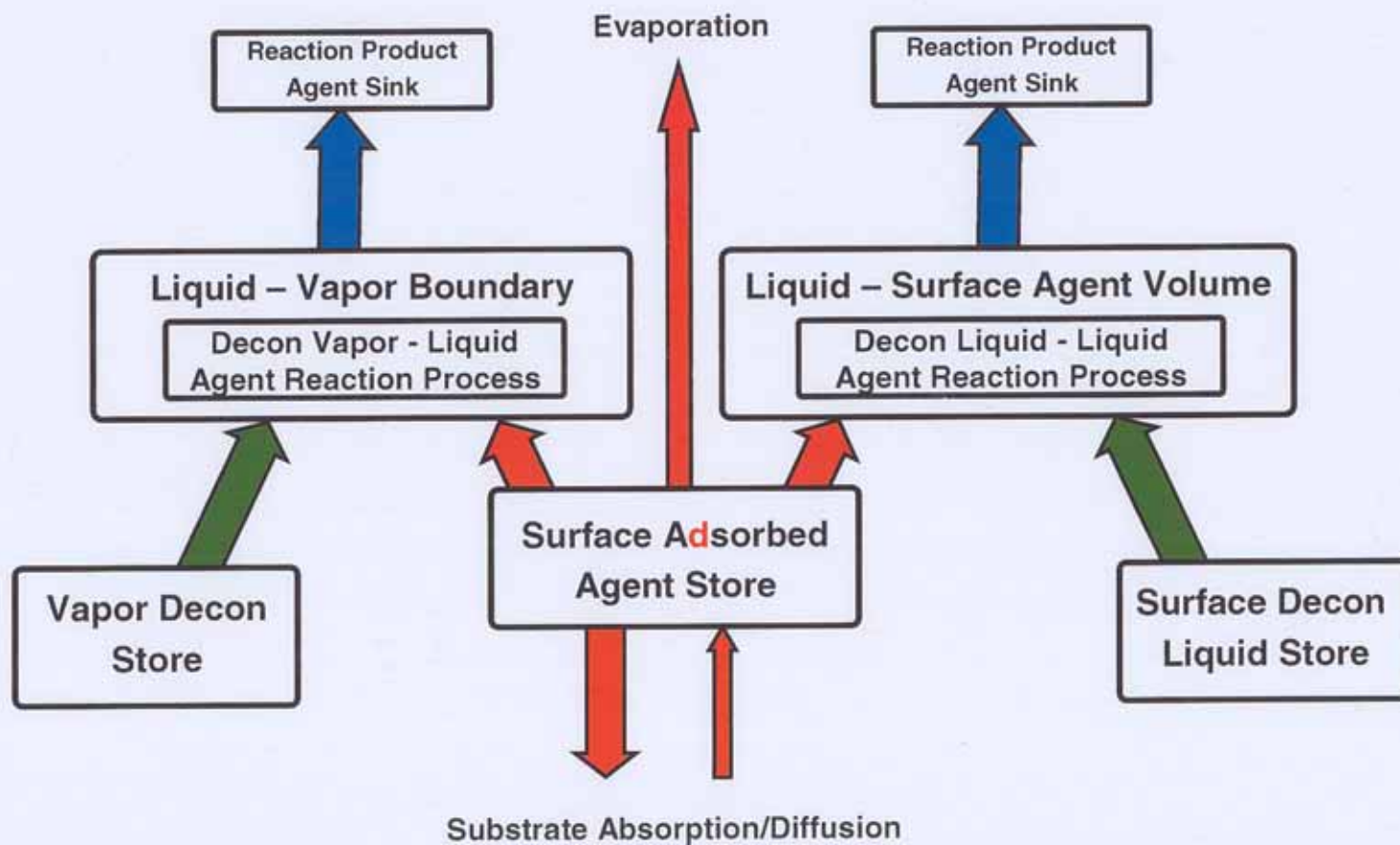
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# Agent Flow: Decontamination Phase (Surface Decon)

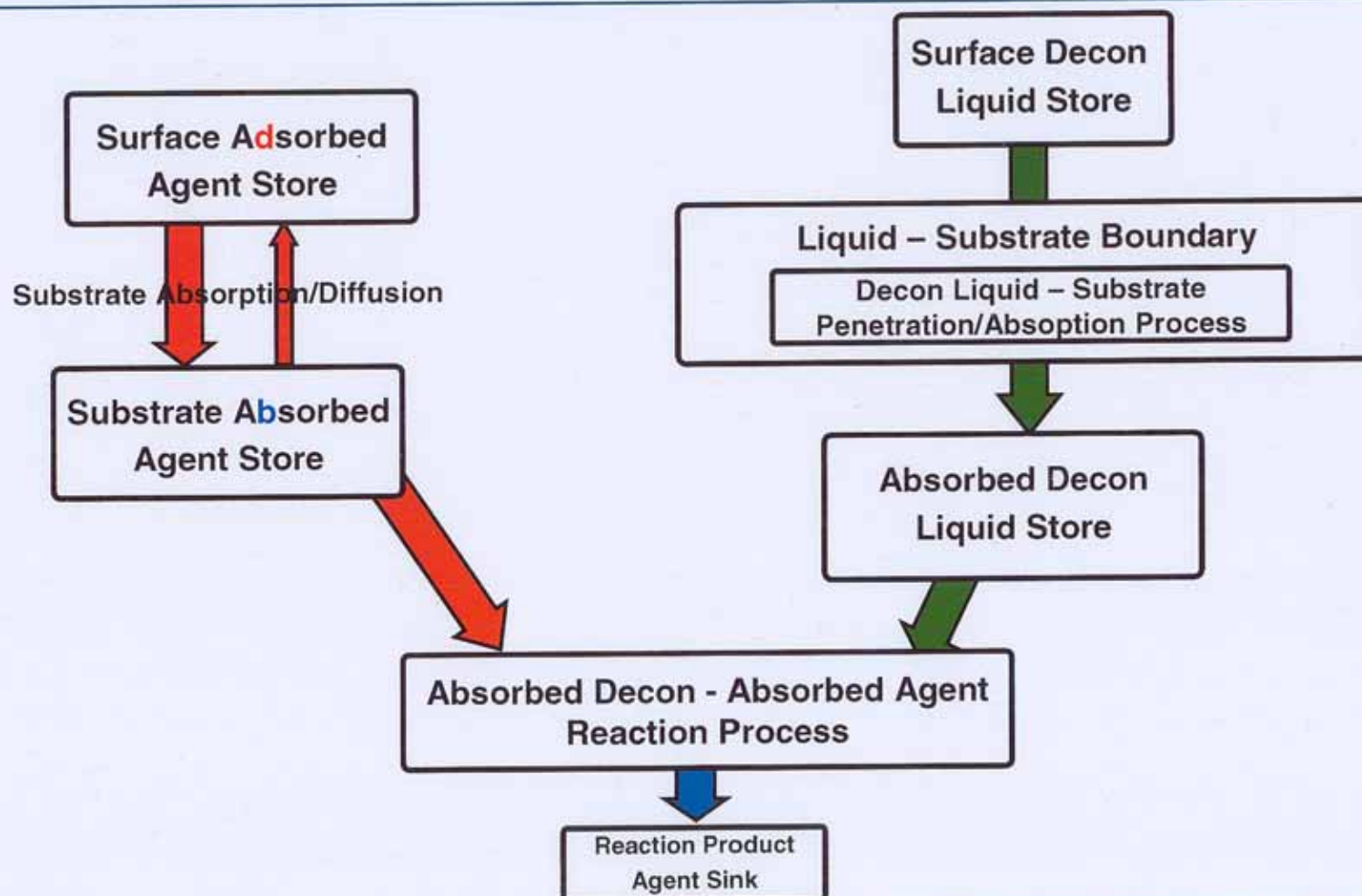


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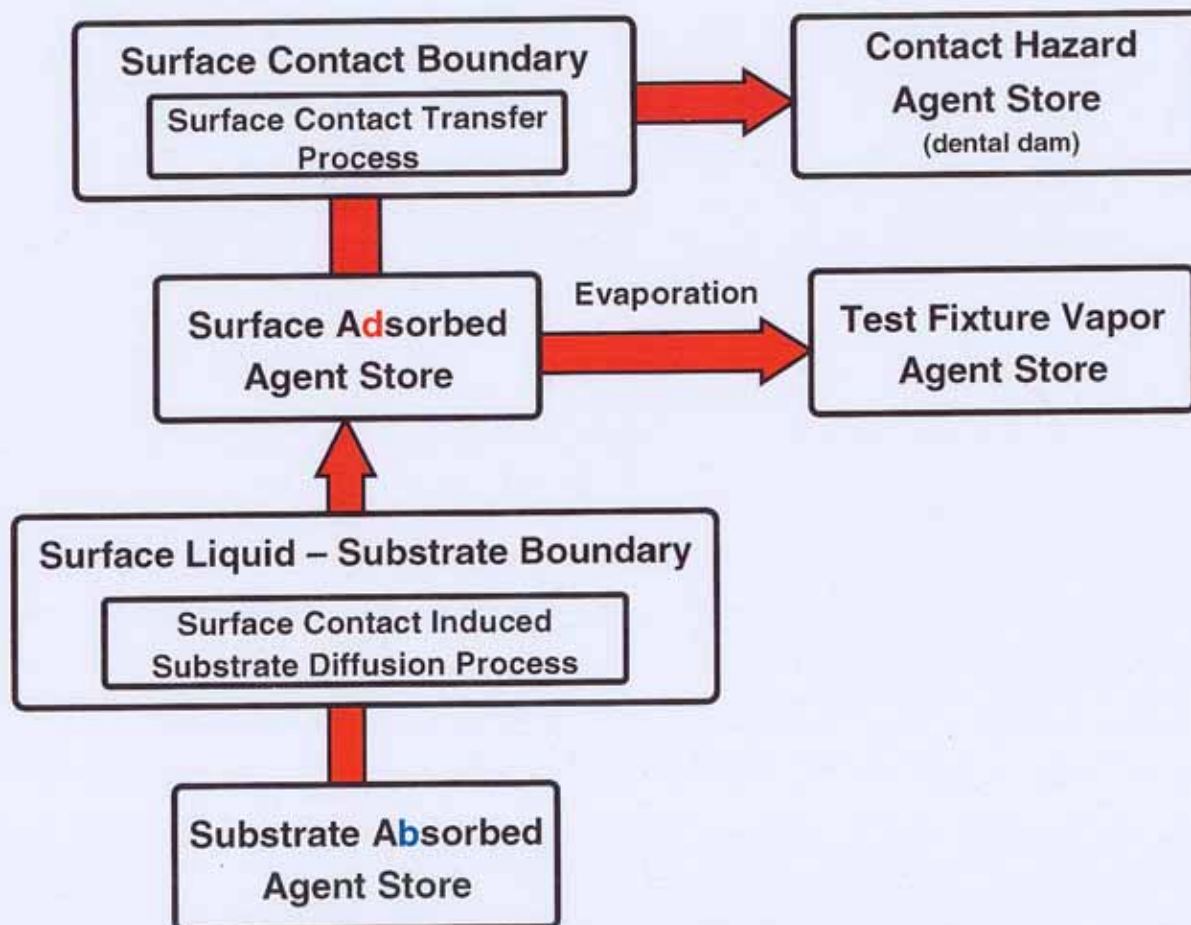
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# Agent Flow: Decontamination Phase (Substrate Penetration Decon)



# Agent Flow: Residual Hazard Phase





# In Summary

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- Proof-of-Principle Prototype (as the ECS Model) has been completed and demonstrated at end of FY05
- Current development effort is projected to reach limited decontamination efficacy prediction capability by end of CY06
- Incorporation of more detailed and advanced functionality will continue in FY07 to allow for more realistic simulations of live agent coupon contamination, aging, and decontamination, the level of effort commensurate with funding



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